Precision farming and IoT case studies across the world (part 1)

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Introduction (1)

- Smart farming is the evolution of precision agriculture - it is based on Internet of Things (IoT)

- This term was coined by Kevin Ashton in 1999: data collected from objects or ‘things’, (e.g., devices, implements, sensors) and processed individually or together with algorithms
  - that correlate the information to help the users to take decisions not based only on position, as is in precision agriculture, but also on data ‘enhanced by context and situation awareness, triggered by real-time events’

Introduction (2)

- The smart farming - based on the collection of data from different sources, as automatic as possible, it is possible to acquire big data without big efforts by the farmer

- Smart farming involves all the actors: farmer, agronomist, consultant and contractors, to collect all possible data from the field and to help the farmer to take the right decisions

- Data collected are exported to the cloud from the tractor and its implement, from various kinds of sensors on the field, proximity or remote multispectral cameras, weather stations, etc.

Introduction (3)

- After an automatic data collection, consultants can analyze the output and give precious results to the farmers
- The case studies presented here deal with the use of satellite imagery for crop canopy vigour mapping, smart irrigation approach,
  proximal sensing sensor developed as major investment by farmers
- Smart irrigation consists in a developing strategy for the agriculture sustainabili ty and there is a huge interest in developing this technology commercially
- The spectrum of the technologies reported in the case studies is between the state of the art and some other relatively known technologies
  - The case studies provide some recent operative advances for some countries: Italy, Greece, France, United States and Japan

France: The digital Mediterranean farm in the south of France…

- This case study shows that precision viticulture (PV) is being adopted by the wine industry and growers
  - It highlights the current needs for training and support for viticulture professionals

- The second aim - the focus on the description of an original case study that aims to promote, through the example of a model farm, the training and support of professionals in the adoption of PV tools and services for vineyard management

Adoption of precision viticulture in France

- This case study is organized into three main sections devoted to the most common PV technologies and services

- Each section provides a brief overview of the adoption and use of these technologies in France
  - These results come from the observatory of the uses of digital agriculture (https://agrotic.org/observatoire/)
  - It was set up in 2016 in association with 24 digital agriculture companies and the #Digitag convergence institute (https://www.hdigitag.fr/en/)

Vigour mapping

- Different services/techniques are used to obtain these maps: satellite remote sensing, airborne images, UAV (unmanned aerial vehicle), on-board sensors (Greenseeker, Physiocap, CropSpec)

- Satellite remote sensing remains the main source of acquisition (approximately 80% of the area) followed by airborne images and UAV

- The use of on-board sensors remains marginal (compared to remote sensing)

- On-board sensors: for mapping vigour in narrow vineyards with row cover crops (Champagne, Bordeaux) where remote sensing may have limitations (mixed pixels, vine confusion for the computation of vegetation indices, etc.)

Soil mapping (apparent electrical soil conductivity or resistivity)

- The soil mapping with apparent electrical conductivity or apparent electrical resistivity is not widespread in France
- This service was applied to less than 1% of the French agricultural area for the last 10 years
- The production of these maps is generally carried out by service companies, which also provide advice on the interpr etation of the maps
- Like remote sensing, soil mapping is used for a large diversity of applications from one vineyard to another
- The main application remains define sampling strategies to delineate homogeneous zones of soil calcium content, to choose the right rootstocks before planting

Type of technology	Estimated area cumulated in 2017 (ha)
Soil apparent resistivity	50,000
Soil apparent conductivity	85,000
Total	135,000

Robots and sensors networks

- Robots are equipped with sensors that can collect data and/or georeferenced observations
- Adoption of robots in viticulture is still at its infancy
- For crops, it is estimated that almost 150 operational robots were used in 2018 in France
- The study identified viticulture as the second for robot adoption including also the robots dedicated to mechanical weeding
- With the exception of meteorological stations, communicating sensors are mainly dedicated to two applications: irrigation control and crop health monitoring (connected to insect traps)
- The connected insect sensors remain relatively developed and applied mainly to the detection of the flights of Eupoecilia ambiguella, which is responsible for the damage on grape bunches

Importance of an exemplary digital wine farm

- The value of digital technology and precision agriculture (PA) for improving the profitability of agricultural operations and/or to mitigate their environmental impact has been highlighted by numerous works

- Some of them have focused on the adoption of new technologies by farmers in most parts of the world, showing that the phenomenon is starting worldwide

- These constraints explain why farmers are sometimes reluctant to adopt PA technologies on their own farm

- The role of these demonstration `digital` farms is also essential to support farmers in making the appropriate technical choices and investments on their own farms

Methods for designing a pilot digital farm for PA demonstrations (1)

- Agtech companies, such as SMAG (a major player in agricultural software in France) and Vivelys (an innovative company in managing grape and wine production)

- It has a very important economic, social and environmental impact because it represents more than 250,000 ha (nearly 40% of the region`s agricultural area) with more than 19,800 farms

- Digital agriculture and PA have been identified as drivers for placing wines production in a more sustainable, economically profitable and environmentally friendly context

Methods for designing a pilot digital farm for PA demonstrations (2)

- The project operated in flexible manner as the form, organization and funding of the de monstration farm were not known in advance
- The following sections aim to share the approach and methods that have been implemen ted as well as the organization and financing of the different stages
- It is not a question of presenting this experience as an example to follow, but rather of sh aring it so that other similar projects can learn from it
- The cost, human resources and time requirements for each stage are given

Expectations to be met by the digital farm (DF)

- The DF must meet the expectations of three types of stakeholders:
  - (i) for academics (universities and agricultural colleges),
  - (ii) for companies, the DF is a demonstration center for their customers and agricultural professionals and
  - (iii) for viticulture professionals (producers, cooperatives, advisors, etc.)

    - The DF must make it possible not only to understand the contribution of the digital tools on a daily basis but also to identify how they can be integrated into an operational farm

Organization and implementation of digital solutions

- The demonstrative nature of `Le Mas numérique` requires that PA solutions are organized in such a way as to meet major challenges for growers and advisors in the region
- These challenges were used to define and structure two connected processes to showcase PA solutions in a coherent and complementary way
- There identified two major issues for the wine industry:
  - (i) the management and proper use of plant protection products for vine and fruit health and
  - (ii) quality and yield management

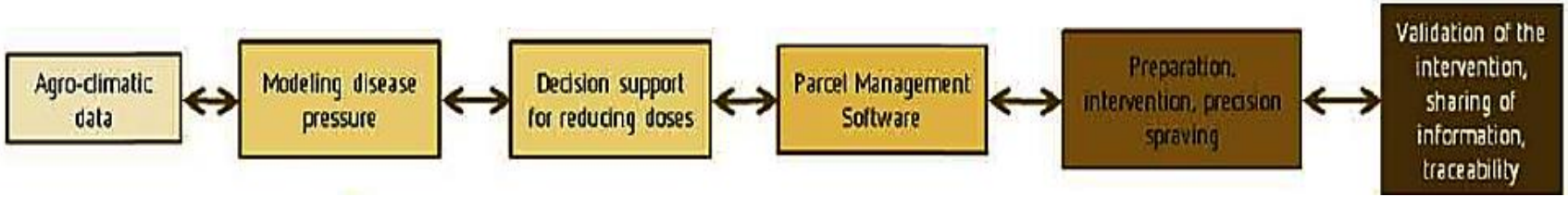
Implementation of solutions

- They had different objectives:
  - (i) to share the deployment of solutions and the prerequisites necessary for implementation,
  - (ii) to promote mutual knowledge of the different solutions deployed to identify possible improvements collectively and
  - (iii) to identify missing complementary functions in the connected processes

- It made it possible to support employees in the field who were confronted with the implementation of 15 new tools/solutions in a few weeks

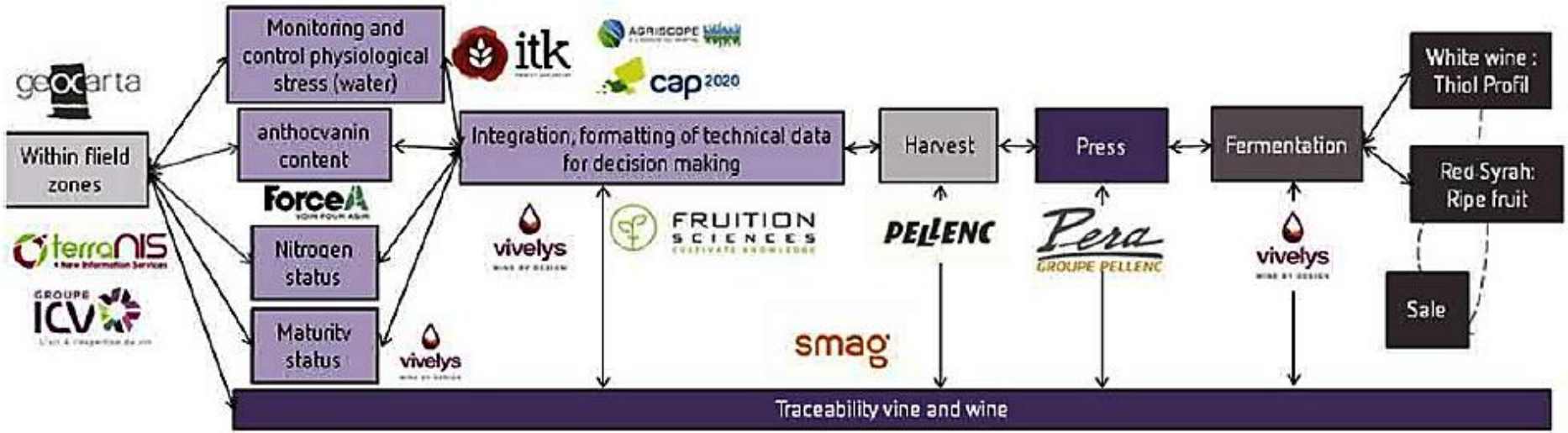
Connected processes

- Each figure shows the succession of unit functionalities that have been implemented to design the connected process
- Data exchanges between the different functionalities (digital solutions) are represented by arrows
- All the connected functionalities which meet a challenge of the wine industry represent a connected process
- It combines the complementary digital solutions



Connected processes (2)

- Functions (and associated PA/digital solutions) of the connected process dedicated to yield and quality management at the Domaine du Chapitre



Summary

- This project aims to provide an example that will enable winegrowers to better consider the choices of precision viticulture techniques and methods
- This is an example and each project of this type will necessarily have specific features that will require different choices
- The integration of the project manager into a research and teaching team has been an important factor for success
- It allows the project manager to benefit from a vision of Agtech and its evolution
- The sponsoring framework model and the agility it allowed were also specific features of the project

Session Q&A